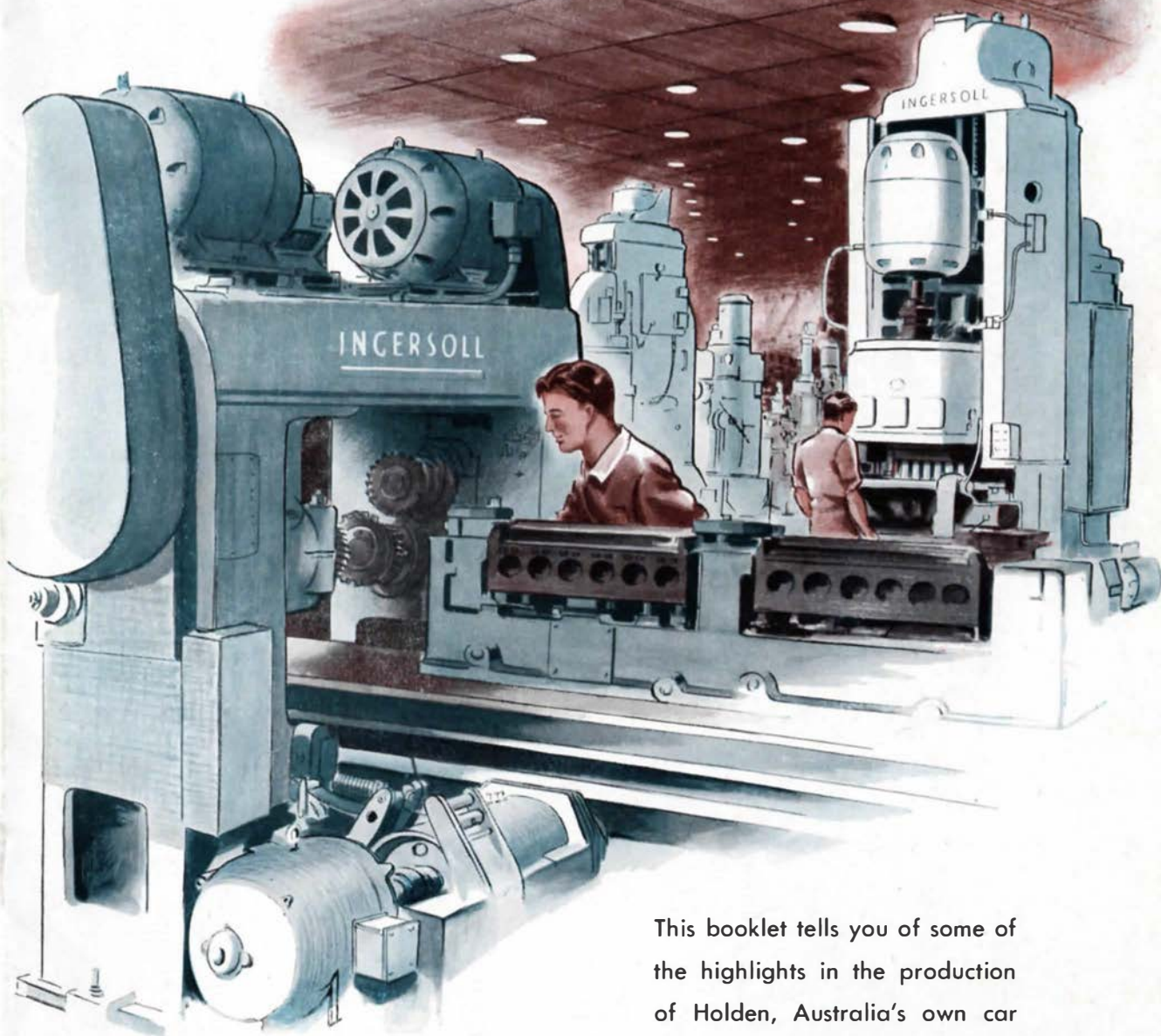


Building General Motors New Australian Car . .

HOLDEN



This booklet tells you of some of the highlights in the production of Holden, Australia's own car

Introduction

This is the story of a great Australian manufacturing enterprise, an enterprise which has the greatest backing of knowledge, skill and resources of any undertaking in Australian industrial history. For behind Holden is General Motors—largest manufacturing organisation in the world, with a production record of over 33,000,000 motor vehicles.

THIS BOOKLET covers just one aspect of General Motors activities in designing and building Holden. This is the manufacturing story.

In other literature relating to the development of the new Australian car, you have been told how Holden was designed and how it was tested. Colourful catalogues, which you will see soon, contain illustrations and specifications of the new car.

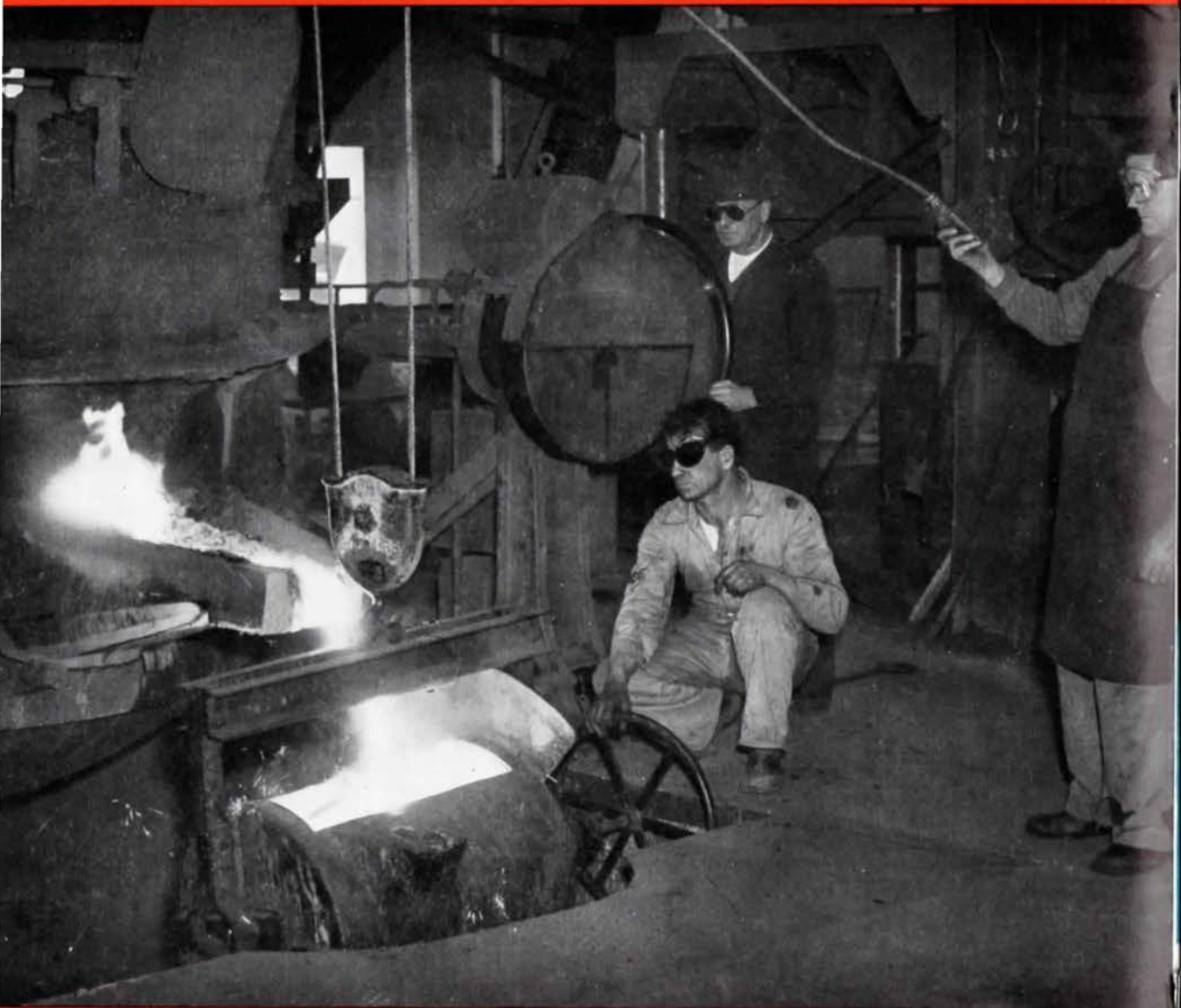
To build Holden, General Motors engineers planned the newly erected manufacturing plant at Fishermen's Bend, Melbourne, and they completely re-arranged the body works at Woodville, Adelaide. The car will be assembled in General Motors plants at Brisbane, Sydney, Melbourne, Adelaide and Perth.

The Fishermen's Bend plant, which will produce complete engines and many other components, is as advanced as any in operation anywhere. Its cost, including the new mechanised foundry, exceeds £2,100,000 and when the first Holden rolls off the production line, General Motors-Holden's will be outlaying in all its Australian operations funds approximating £8,500,000. To assist in the production of Holden, key manufacturing men with many years' experience in England and America, and on the Continent, have come to Australia. A team of skilled Australian tradesmen has been recruited to operate the new equipment, whilst hundreds of untrained men have been absorbed and given months of specialised training.

This, very briefly, tells you the manufacturing background to Holden—a car which will open your eyes to a new conception of value . . . a value you get in better design and accurate, high-quality production. Holden is a car that can proudly take its place beside such famous General Motors vehicles as Cadillac, Buick, Oldsmobile, Pontiac, Chevrolet and Vauxhall.

Casting Engine Components

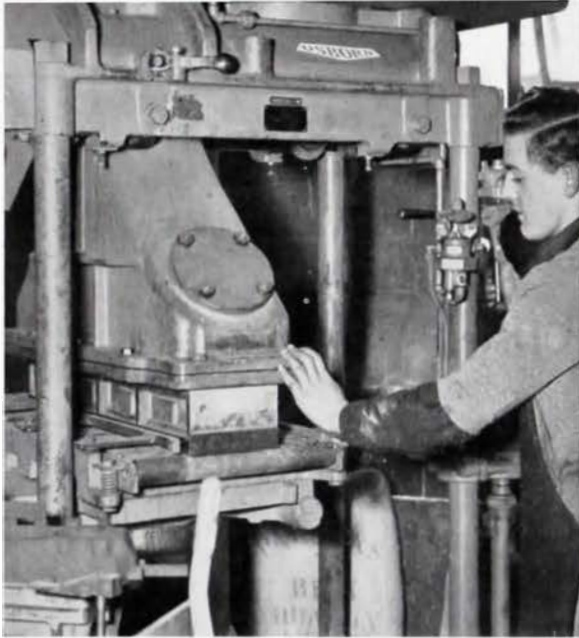
Castings will be produced in General Motors new mechanised foundry at Fishermen's Bend, which is as well equipped as any automotive foundry in the world.



The latest overseas foundry techniques, many of which are new to Australia, have been adopted to ensure the absolute precision of all castings. Some of the major parts of Holden's engine including the cylinder block, cylinder head, transmission cases and the valve tappets, are made of nickel chrome alloy cast iron.

Phases of foundry operation are shown in the action pictures on these two pages.

The illustration above shows molten nickel chrome alloy cast iron, heated to 2800° Fah. being poured from an electric tilting furnace into a ladle. Before pouring, the metallic composition of the molten metal is checked by metallurgists.



Sand cores for shaping the water passages and other cavities in the cylinder head are shown being made here. Select-graded sand of the proper mixture is blown into a core box and baked in special ovens.



Sand cores for the cylinder block are set into mould boxes on the conveyor line. The settings have been accurately gauged because absolute precision is necessary if cylinder walls are to be of even thickness.



Holden push rod tappets are formed in these moulds shown on the conveyor line. In this operation the ends of the tappets are chilled and hardened giving them a glass hard, long-wearing surface.



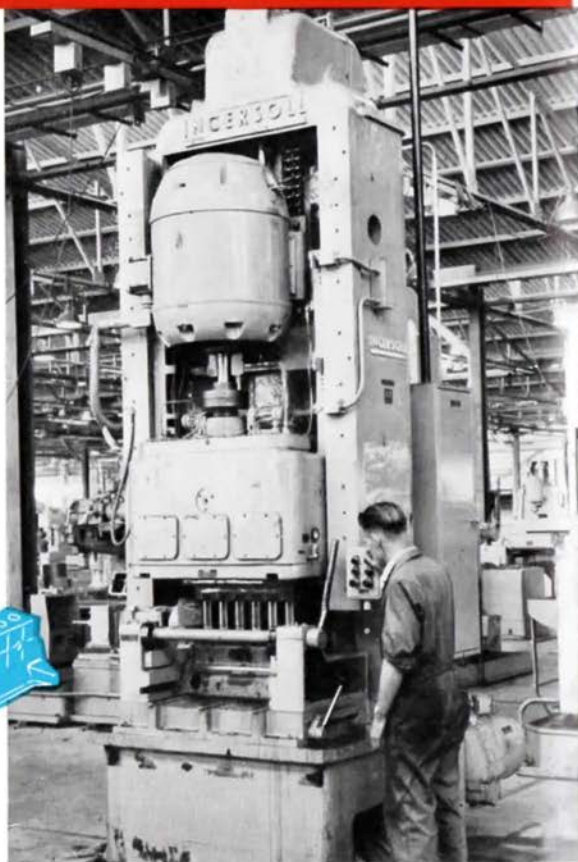
This machine is making sand moulds used to shape the outside of transmission cases. The sand is automatically mixed, fed into the mould and rammed till it takes the exact shape of the pattern.

In the Machine Shop

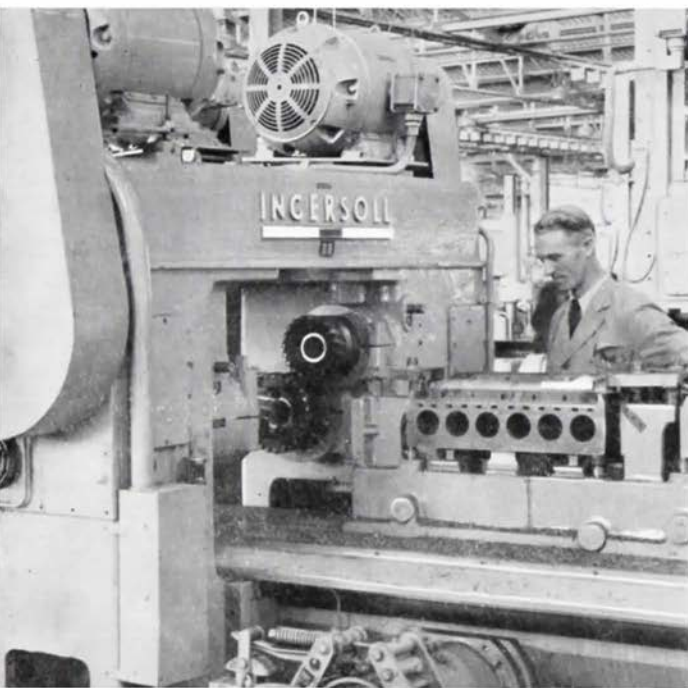
No photograph or series of photographs can do justice to the magnificent new manufacturing plant covering 126,000 square ft. at Fishermen's Bend.

The manufacturing plant is as advanced as any automobile plant of its kind in the world. It is packed with new machines and employs many production techniques completely new to Australia. It's in the machine shop that raw materials and semi-finished components, including castings such as the cylinder block, and forgings such as the crankshaft, are fashioned into finished components. These components are then conveyed to the engine assembly area where they are assembled into complete engines and finally tested, after which they are ready for the vehicle assembly lines.

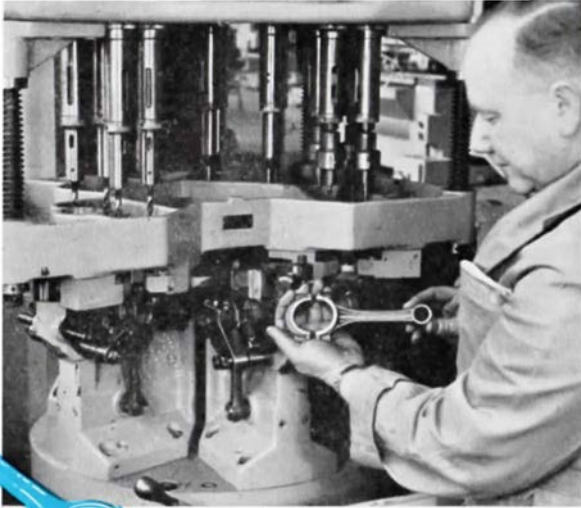
In the engine plant more than 1800 separate operations of machining, drilling, grinding, cutting and finishing are carried out. Each operation has been planned down to the last detail so that production will be on the most efficient scale. Many parts are made to tolerances as fine as $1/10,000$ th of an inch on machines which are designed to produce components of uniformly high quality on a mass production basis.



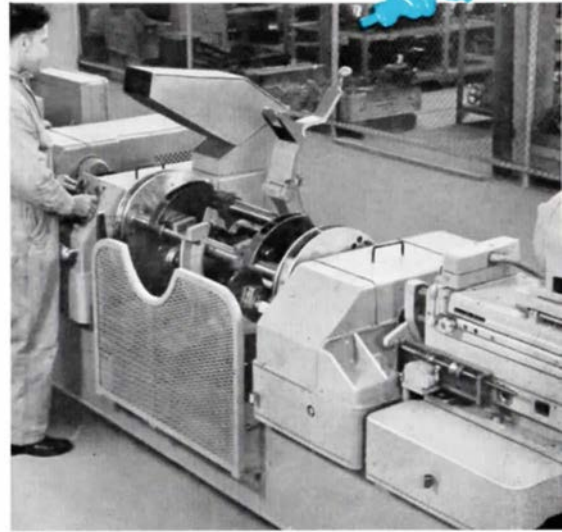
The Ingersoll Vertical Cylinder Boring Machine shown above semi-finishes cylinder bores in 30 seconds. All bores are machined at one time, ensuring perfect alignment. This machine was specially designed for the manufacture of Holden engines.



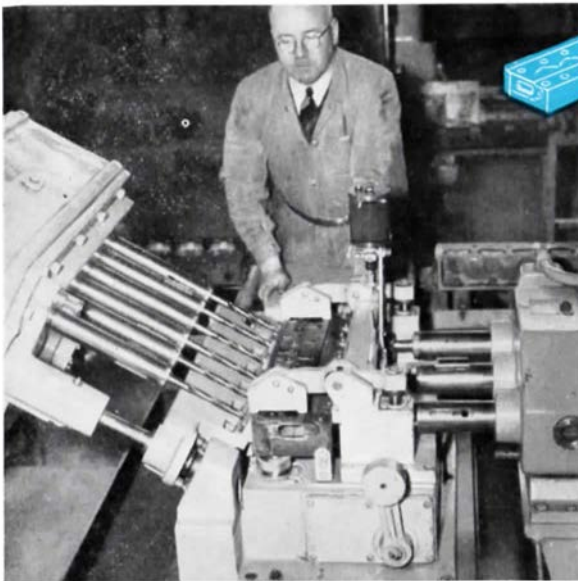
Cylinder block castings come direct from the foundry to this Ingersoll 8 Spindle Milling Machine. It mills the blocks top and bottom so that cylinder heads and oil pans can be accurately fitted. Bearing locks are also broached in this same operation.



In less than 20 seconds this machine drills and reams a connecting rod and its cap. The two parts are machined together to assure perfect alignment.

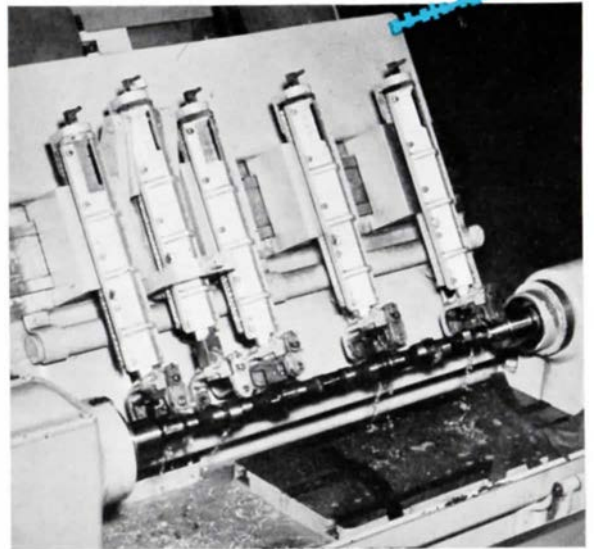


The latest advancement in Crankshaft production. A Mass balance and centring machine developed by General Motors Research Department to ensure perfect balance in all shafts.



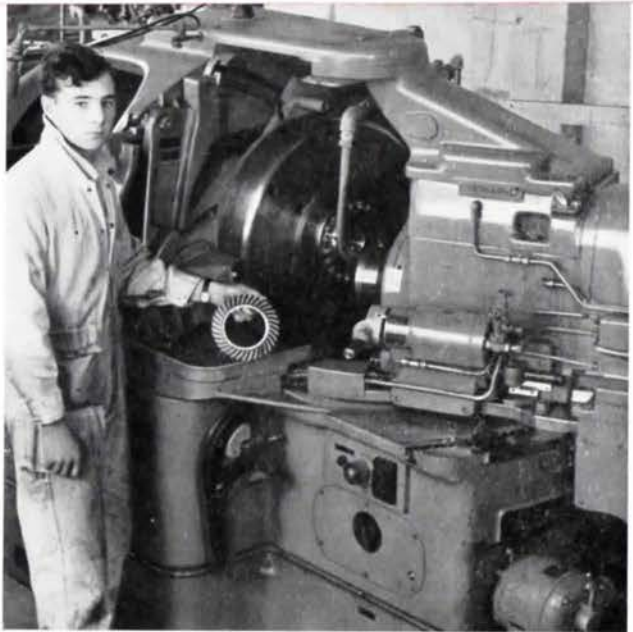
Spark Plug holes and inlet port holes in the cylinder head are drilled simultaneously by this NATCO 2-Way Multiple Spindle Drill. It completes the operations in less than one minute.

All Camshaft bearings are super-finished at the one time by the Gisholt Camshaft Superfinisher. Superfinishing ensures a close, smooth fit of bearing surfaces and freedom from undue friction. A similar machine superfinishes all crankshafts.

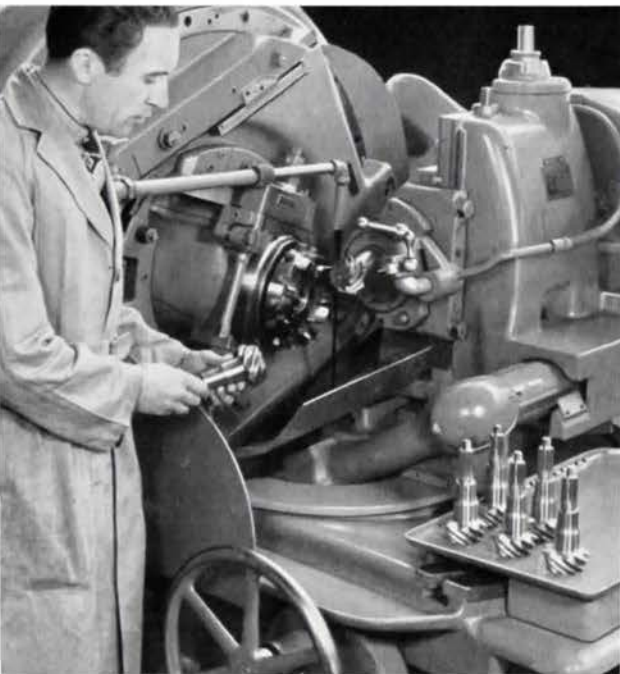


Gear Cutting

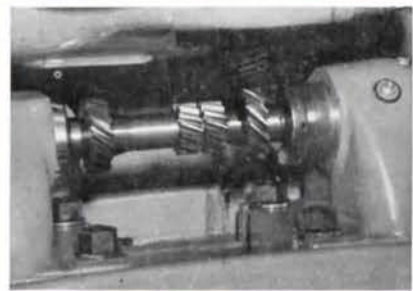
Precision gear cutting is a specialised field which requires the guidance of experts and the use of the most intricate equipment. Top-line gear men have come to Australia to establish the control of production on the Holden gears. They have installed the finest equipment including special tool-sharpening machines that haven't before been released for operation outside the plants of the original manufacturer. So that they will stand up to constant wear and give perfect mating, Holden gears are cut from carefully selected blanks, they are heat-treated and are finally finished to dimensional tolerances which, in some cases, are as fine as $1/10,000$ th of an inch.



The operator of a modern Gleason Gear Cutting Machine is shown with a Spiral Hypoid Ring Gear, the teeth of which have been semi-finished cut. In the finishing operation that follows, approximately $5/1000$ ths of an inch of stock will be removed from the face of the teeth, thus producing the finished gear to very close limits.



The rear axle drive pinion is cut to a mirror finish on this Gleason Spiral Bevel Generator. The cutting blades are trued up to an accuracy of $1/10,000$ th part of an inch, and the sides of the teeth are finished to a tolerance of $1/1000$ th of an inch. This extreme accuracy in cutting gear profiles ensures that the rear axle pinion will mate perfectly with the ring gear and give a smooth, quiet, long-wearing drive.



After being semi-finished approximately to size and heat treated, many gears, including those for the transmission, are placed in the Red Ring Gear Shaver, which compensates for any variations in respect to size and shape. This machine produces gears with a perfect finish ensuring quiet, efficient operation and long life.

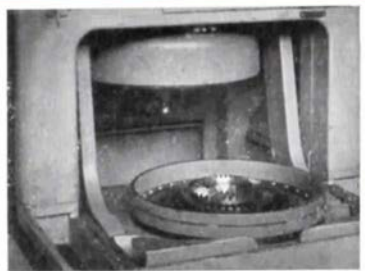
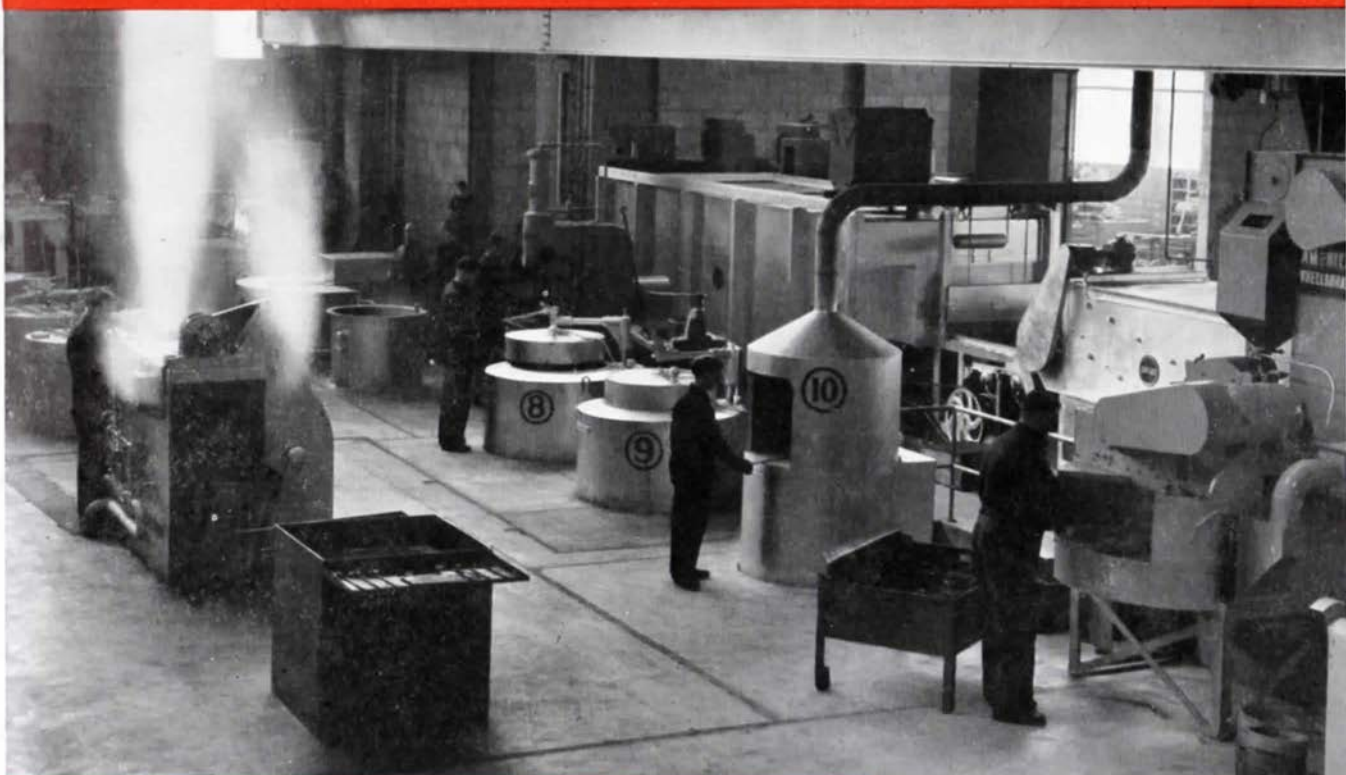
Heat Treatment

General Motors-Holden's new Heat Treat Department covering 8000 square feet, at Fishermen's Bend, Melbourne, has been designed on the most modern lines to meet two essential requirements in mass production of motor cars: quality output, coupled with quantity production.

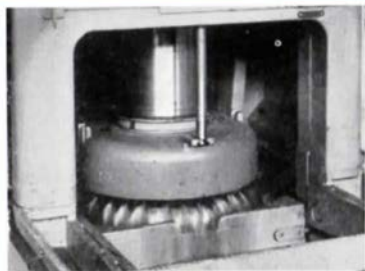
All Forgings when received, for General Motors new car, are heat treated either by Hardening and Tempering or Annealing, before they are sent to the Machine Shop. Heat Treating at this stage ensures that the steel is of a uniform hardness and

desired structure, which gives good machinability, tool life and finish, and eliminates all forging stresses in the steel.

After machining of the various components such as Drive Gears and Pinions, Transmission and Differential Gears, and all other parts that require a hard wearing surface, they are again sent to the Heat Treat for final treatment. During this process a rigid inspection is maintained to ensure that the components are up to General Motors standards and specifications.



The Gleason Press shown in this view is used for the hardening of Drive Gears and Flywheel Ring Gears. The Gears after the proper heating are placed on a die in this press which hardens the Gear and at the same time, prevents distortion and run-out.



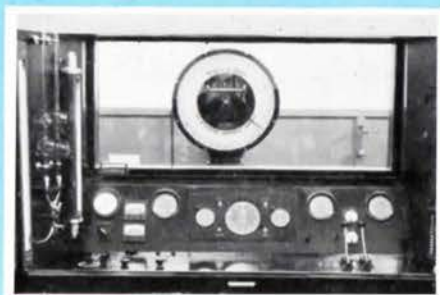
Above is shown a section of the production Heat Treating Department. The equipment includes installations used for Carburizing, Hardening, Washing and Tempering of parts. An Induction High Frequency Hardening machine is also installed in the Heat Treat which is used for miscellaneous parts, such as Shock Absorber Cams and Shafts, Rocker Arms and Racker Arm Shafts.

Inspection

The Inspection Department is responsible for preserving the quality and uniformity of every part and the performance of assemblies such as the body, engine, steering, transmission and axles.



In the G.M.-H. Laboratory, materials including complex special steels, are checked before they are released for production. In addition, castings and forgings are checked to ensure that they have the correct metal structure and grain flow.



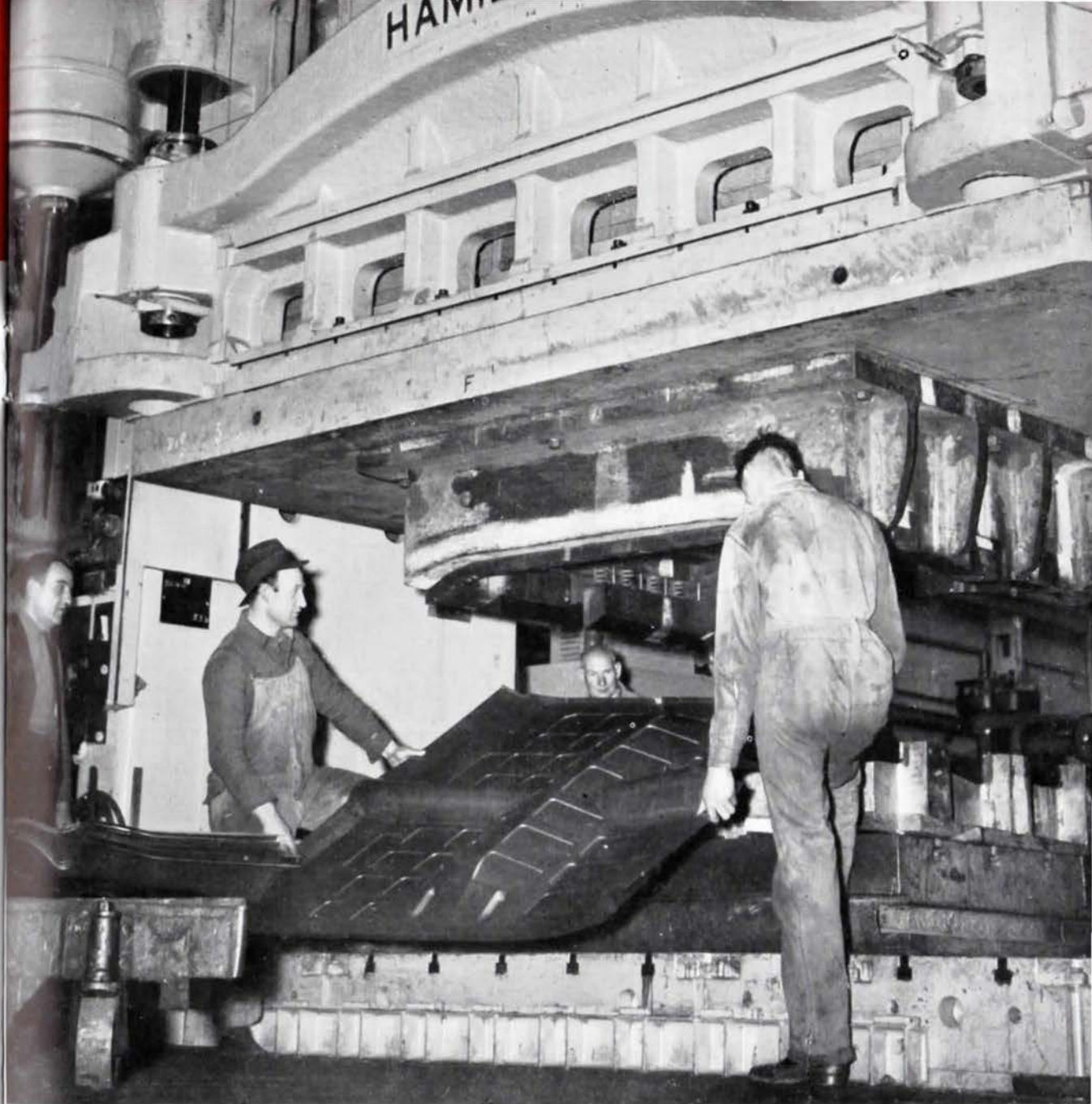
The Engineering Department regularly carries out independent performance tests of engines on the Dynamometer (shown above). The Dynamometer provides accurate measurements of engine performance. In addition every Holden engine is run under its own power at 1,200 r.p.m. and final checks are made. After the test run, moving parts and cylinder bores are closely inspected visually.

The activities of the Inspection Department extend over every phase of the building of Holden from the analytical checking of raw materials to the testing of complete vehicles before their delivery to General Motors Distributors and Dealers.

To ensure that every part and every assembly fully meets the rigid specifications laid down by the engineers, basic standards are established. Against these standards, parts are compared at every stage of manufacture. Nothing is left to chance. Highly trained inspectors, using intricate gauges and precision testing equipment, are engaged constantly in checking and re-checking the physical, chemical and metallurgical properties as well as the dimensional and functional characteristics of parts and assemblies.



The Fellows Involute Measuring Instrument provides a rapid means for checking to an accuracy of 1/1000th part of an inch the tooth profiles on high quality transmission gears. It is particularly important that the profiles be accurate because transmission gears operate at such high speeds.



Building the Body

Huge presses, like this one which exerts a pressure of 1500 tons, are needed to shape and "stamp out" parts of bodies. This picture and those on the next page show you phases in the building of bodies at General Motors own body plant at Woodville, South Australia. But they can't possibly illustrate the immensity of this body plant, which is the greatest in the Southern Hemisphere. The Woodville plant has been completely re-

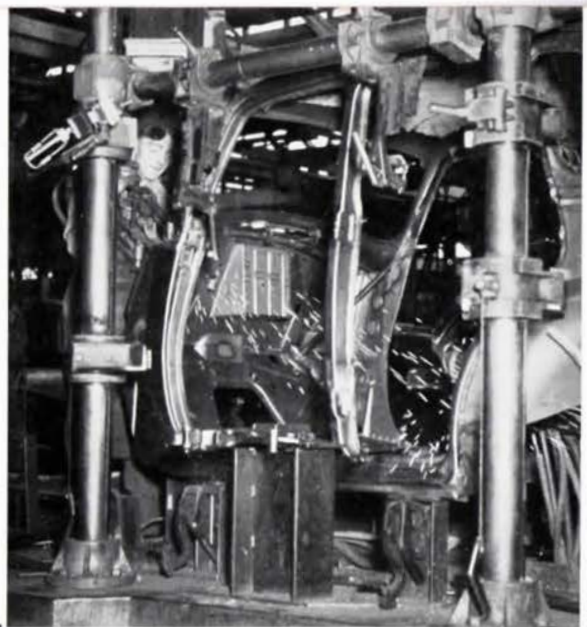
arranged and new equipment installed at a cost of £1,750,000 to produce the "Aerobilt" bodies for Holden. The bodies are termed "Aerobilt" because their design embodies engineering principles similar to those used in modern aircraft. The new plants that have been built and the new machines that have been installed will enable Woodville to build a finer body than ever before in their 20 years' experience of building fine bodies.

Body Assembly

To make Holden's "Aerobilt" body, many individual pieces of steel such as the floor, the turret top and the door pillars have to be pressed. These pressings then go to the Body Assembly plant where skilled men weld the pieces into a single unit of steel. An entirely new plant has been built for the assembly of bodies for Holden, and welding equipment which is as fine as anything in the world has been installed. Personnel who went abroad to study the latest methods of welding were able to impart their knowledge in planning this equipment to do a specialised job on Holden.



The illustration above shows a body passing through a spray booth where it is receiving one of three separate coats of body lacquer.



Vivid flashes of light shoot out as an operator welds steel sections of the body into a unit of exceptional strength.

Once bodies are assembled they are ready for the paint shop. A new plant for this purpose has recently been completed at Woodville. It cost £132,000 and is equal to the world's best.

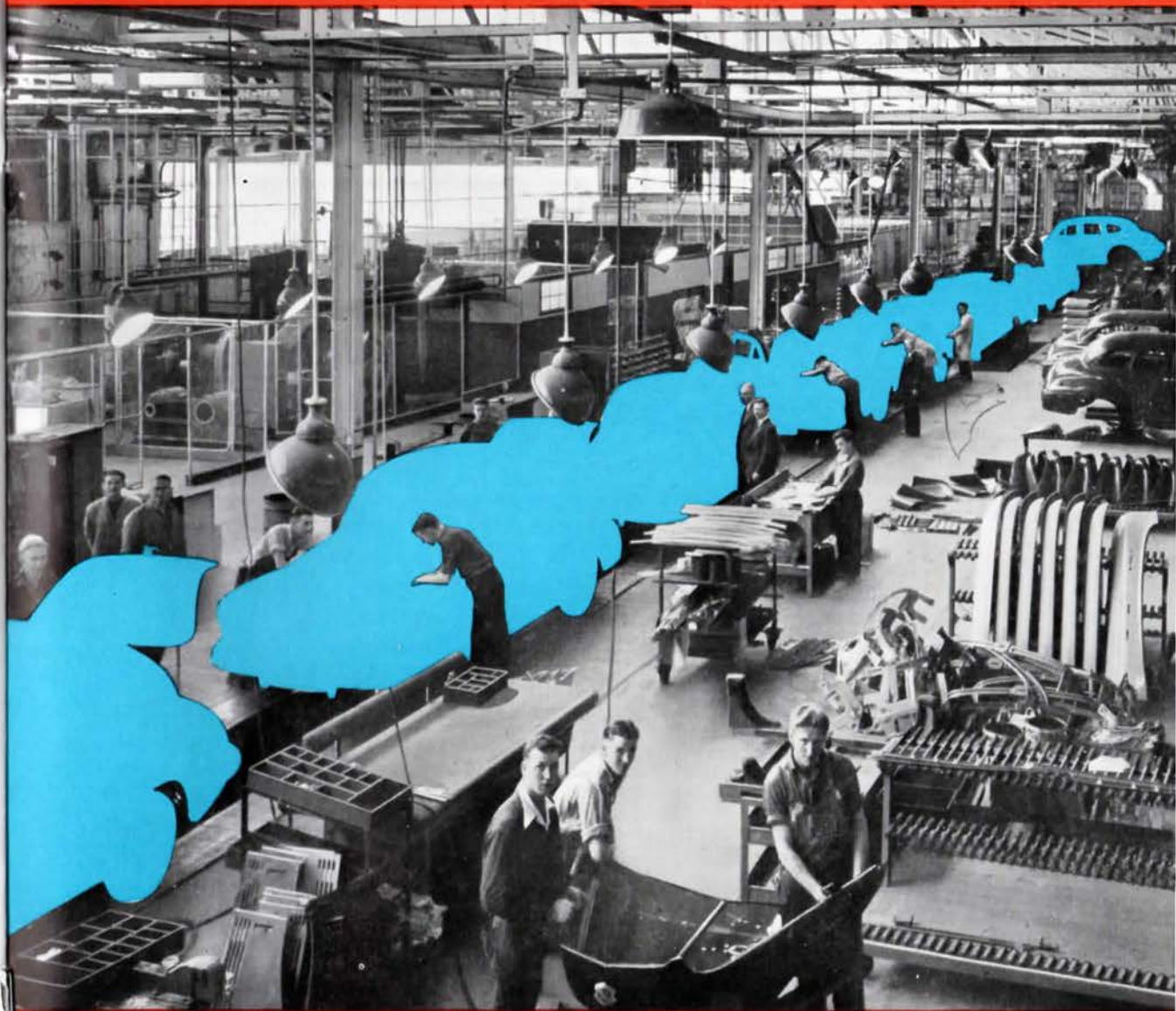
Bodies are carried on a fully mechanised conveyor line which is two-thirds of a mile long. They pass through a series of automatic washing and spray booths where they are sprayed with a special solution. The solution thoroughly cleans the steel and also provides a better basis for subsequent painting. Bodies are then run through a bath which coats every inch of the under body and the lower portion of the body sides with a generous coat of primer. Next the bodies enter spray booths where they take two primer surfacer coats and finally three separate coats of body lacquer. All along the line there are huge ovens, including one that's 130 yards long, which bake the primer and lacquer coats on to the steel.



In the final stages of Holden body building, the bodies are carried on conveyors along the Trim Assembly lines. They are insulated, linings and carpets are put in; seats, safety glass, door handles and locks are fitted. During assembly and at the end of the line, body work is critically inspected, finishing touches are added, and the bodies are then ready for shipment.

Final Assembly

The final assembly actually is the "fitting" line where bodies, engines and other interchangeable parts, all carefully made beforehand to rigid specifications, are assembled.



The final assembly is an efficient, smooth-flowing line where detailed planning ensures that the right sub-assembly is at the right place at the right time. On the assembly line there are no giant presses such as those which stamp out great sheets of

metal for bodies at Woodville. Nor are there any of those precise machine tools used for making engine parts. The fitting together to make the finished products is a matter of individual skills and craftsmanship.

Invitation

Towards the end of this year, Holden cars will be rolling off the production lines in General Motors plants throughout Australia.

We would welcome the chance to show you over the plants in which the car is being built—the foundry and machine shop at Fishermen's Bend, and the body building plant at Woodville.



GENERAL MOTORS – HOLDEN'S LIMITED

BRISBANE — SYDNEY — MELBOURNE — ADELAIDE — PERTH



HEAD OFFICE, MANUFACTURING & MAIN ASSEMBLY PLANT,
AND NASCO, FISHERMEN'S BEND, MELBOURNE, VICTORIA



BODY BUILDING AND MANUFACTURING PLANT WOODVILLE S.A



ASSEMBLY PLANT,
PAGEWOOD, NEAR SYDNEY, N.S.W.



ASSEMBLY PLANT,
PERTH, W.A.



ASSEMBLY PLANT,
THE VALLEY, BRISBANE, Q'LAND.

ASSEMBLY PLANT,
BIRKENHEAD, S.A.



